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ELEVATOR ASSEMBLY WITH EXTENDABLE SILL

1. Field of the Invention

This invention generally relates to an elevator with an extendable sill that bridges an operating gap between an elevator car and a landing. More particularly, this invention relates to a sill that extends outwardly underneath an elevator door to engage a landing structure.

2. Description of the Relevant Art

Elevator cars move upwardly and downwardly within a hoistway between landings. Sufficient running clearance must be maintained between the exterior of the elevator car and the hoistway walls to allow the car to move quickly and efficiently within the hoistway. If the running clearance is minimized, ride quality is decreased and car guidance system component wear is increased. If the running clearance is maximized, ride quality is improved but a large operating gap between the elevator car and a landing is created, which is undesirable.

One solution has been to use a pendulum car system. The pendulum car operates with an increased running clearance between the car and the hoistway walls, which provides a softer ride and decreases guidance system component wear. When the car reaches the selected landing, the car swings closer to the landing to reduce the operating gap between the car and the landing. One problem with this solution is that the lateral movement of the car creates occupant ride quality issues. Another disadvantage with this system is that a large amount of energy is required to move the car in a lateral direction. Further, if the system fails there is still a large gap between the car and the landing.

This invention provides an improved arrangement for bridging the operating gap between an elevator and landing while still maintaining sufficient running clearance and avoiding the other difficulties mentioned above.

SUMMARY OF THE INVENTION

In general terms, this invention is an extendable sill that bridges the operating gap between an elevator car and a landing. The sill extends outwardly

from underneath an elevator car to contact a landing structure, such as a landing sill. A locking mechanism secures the sill to the landing structure preferably before elevator and landing doors open.

In one example, the locking mechanism includes an actuator that drives an engagement arm having a hook portion on one end. A pin is mounted to the landing structure. As the sill moves towards the landing structure, the actuator moves the hook portion into engagement with the pin. When a command is received to move to a different landing, the actuator releases the hook portion from the pin and the sill is returned to a retracted position.

Another example of a locking mechanism utilizes an electromagnet and solenoid actuator. The solenoid moves the electromagnet into contact with a magnetic target positioned on a hoistway wall. Optionally, solenoids with locking elements could also be used to hold the car in place within the hoistway.

In another example, the sill is moved horizontally and vertically to adjust for misalignment between an elevator car floor and the landing. The sill can be mounted to extend along a linear path and can be mounted to rotate downwardly from a position above the landing structure into engagement with the landing structure.

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A schematically illustrates an elevational view of an elevator assembly mounted within a hoistway, incorporating the subject invention.

Figure 1B schematically illustrates a cross-sectional view of the elevator assembly of Figure 1A.

Figure 2 schematically illustrates an elevator door assembly with an extendable sill that is aligned with a landing door assembly where the elevator and landing doors are in a closed position.

Figure 3 is a similar to Figure 2 but shows the sill in an extended position with the elevator and landing doors remaining in a closed position.

Figure 4 is similar to Figure 3 but shows the sill in an extend position with the elevator and landing doors in an open position.

Figure 5 schematically illustrates an elevator door assembly with the extendable sill and locking mechanism that is in an unlocked position.

Figure 6 is similar to Figure 5 but shows the locking mechanism in an intermediate position between the unlocked and locked positions.

Figure 7 is similar to Figure 6 but shows the locking mechanism in the locked position.

Figure 8 schematically illustrates an example of a locking mechanism.

Figure 9 schematically illustrates the locking mechanism of Figure 8 incorporated into an elevator system.

Figure 10A schematically illustrates another example of a locking mechanism in the unlocked position.

Figure 10B schematically illustrates a return mechanism for the locking mechanism of Figure 10A in the unlocked position.

Figure 11A is similar to Figure 10A but shows the locking mechanism in the locked position.

Figure 11B is similar to Figure 10B and schematically illustrates the return mechanism for the locking mechanism of Figure 11A in the locked position.

Figure 12 schematically illustrates an example of a sill used to accommodate misalignment between the elevator car and landing.

Figure 13A is similar to Figure 12 but shows the elevator car being higher than the landing.

Figure 13B is similar to Figure 12 but shows the elevator car being lower than the landing.

Figure 14 schematically illustrates another example of an elevator car assembly incorporating the subject invention.

Figure 15A schematically illustrates another example of an actuator and locking mechanism in the unlocked position.

Figure 15B illustrates the actuator and locking mechanism of Figure 15A in an intermediate position.

Figure 15C illustrates the actuator and locking mechanism of Figure 15A in the locked position.

Figure 16A schematically illustrates another example of an actuator and locking mechanism in the unlocked position.

Figure 16B illustrates the actuator and locking mechanism of Figure 15A in an intermediate position.

Figure 16C illustrates the actuator and locking mechanism of Figure 15A in the locked position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As seen in Figures 1A and 1B, an elevator assembly 20 is mounted within a hoistway 22 for movement between landings 24 (only one is shown). An operating gap 26 is maintained between an exterior surface 28 of an elevator car 30 and hoistway walls 32. The operating gap 26 is large enough to provide sufficient running clearance between the hoistway walls 32 and the elevator car 30 as the elevator assembly 20 moves within the hoistway 22 between landings 24.

The elevator car 30 includes an elevator door assembly 34 that moves between open and closed positions. When the elevator car 30 stops at one of the landings 24 to load or unload passengers or cargo, the elevator door assembly 34 aligns with a landing door assembly 36. A sill 38, supported by the elevator car 30, extends outwardly from the car 30 toward the landing door assembly 36 to bridge the operating gap 26 between the elevator door assembly 34 and the landing 24. The sill 38 extends out from underneath the elevator door assembly 34 and moves along a linear path to engage a landing structure 40, such as a landing sill. The sill 38 in this example comprises a plate member that presents a continuous unbroken surface such that there are no gaps between the elevator 34 and landing 36 doors.

As shown in Figure 2, the elevator door assembly 34 includes first 34a and second 34b doors that are supported on tracks 42 for movement relative to a car frame 44 between open and closed positions. A seal 46 is positioned between the car frame 44 and the doors 34a, 34b to reduce airborne noise levels within the

elevator car 30. The landing door assembly 36 includes first 36a and second 36b doors that are supported for movement relative to a landing door frame structure 48.

A door moving mechanism 50 includes an interlock to open and close the car 34a, 34b and landing 36a, 36b doors together once the sill 38 is extended and locked into place. Any type of door moving mechanism and interlock as known in the art could be used. Further, the operation of door moving mechanisms and interlocks are well known and will not be discussed in detail.

When the elevator doors 34a, 34b are in a closed position, the seal 46 is compressed between the doors 34a, 34b and the car frame 44, and the sill 38 is in a fully retracted position underneath the doors 34a, 34b. This compressive force is applied due the configuration of the tracks 42. The tracks 42 include a first portion 42a that is generally straight and a second portion 42b that is non-parallel to the first portion 42a. The second portion 42b is preferably curved, such that the doors 34a, 34b are drawn inwardly against the car frame 44 to compress the seal 46. The seal 46 and associated track configuration in one example are described in greater detail in co-pending application entitled "Elevator Door Assembly With Compression Seal," herein incorporated by reference.

Once the car 30 is at the landing and the elevator doors 34a, 34b are aligned with the landing doors 36a, 36b, the sill 38 begins to extend outwardly from underneath the doors 34a, 34b toward the landing structure 40, as shown in Figure 3. The sill 38 moves along a generally linear path that extends directly between the elevator doors 34a, 34b and the landing doors 36a, 36b. The doors 34a, 34b also move outwardly away from the car frame 44 along the second portion 42b of the tracks 42. The sill 38 preferably moves at a faster speed than the speed that the doors 34a, 34b move to uncompress the seal 46, to quickly bridge the operating gap 26.

In one example, door movement is dependent on the sill position. Once the sill 38 connects to the landing structure 40, the door operator or moving mechanism 50 is enabled for moving the doors to the open position. The sill 38 is locked across the door threshold and both the elevator doors 34a, 34b and landing doors 36a, 36b open, as shown in Figure 4. The sill 38 remains locked to the landing structure 40

until a command is received to close the doors 34a, 34b, 36a, 36b and move the elevator car 30 to a different landing 24.

An example of a locking mechanism for locking the sill 38 to the landing structure 40 is shown generally at 52 in Figures 5-7. The locking mechanism 52 includes an arm 54 mounted at one end to an actuator 56. An engagement hook 58 is formed or attached to an opposite end of the arm. The arm 54 is coupled with the sill 38 such that they move together. A pin 60 is mounted to the landing structure 40 (i.e., the landing sill). The actuator 56 moves the arm 54 such that the hook 58 is forced into engagement with the pin 60 (see Figure 6). Once the hook 58 is securely locked into place with the pin 60, the sill 38 is in the fully extended and locked position, the door moving mechanism 50 is enabled, and the elevator doors 34a, 34b and landing doors 36a, 36b can now be opened (see Figure 7). A resilient spring member 62 returns the arm 54 to a retracted, unlocked position (see Figure 5) when the force provided by the actuator 56 is released.

This locking mechanism 52 operates in a manner similar to that of a sliding door locker. While a pair of locking mechanisms 52 is shown in Figures 5-7, it should be understood that a single locking mechanism 52 or additional locking mechanisms 52 could be used, depending on the size of the elevator and/or the elevator application.

An example of an actuator and locking mechanism 63 is shown in Figures 8 and 9. The actuator and locking mechanism includes an electromagnet 64 connected to an electrical power source 65 preferably comprising a solenoid. The electromagnet 64 is mounted for movement with a shaft 66 controlled by the solenoid 65. A spring 67 provides retraction for the shaft 66 and electromagnet 64. The actuator and locking mechanism would operate as follows. The car 30 stops and the electromagnet 64 and solenoid 65 are both actuated together by a cannon power source 69. The electromagnet 64 engages a steel target 71 mounted within the hoistway 22. This results in a drop in coil resistance, the solenoid 65 turns off, and the electromagnet 64 holds or locks the car 30 in place. Prior to departure, the electromagnet 64 turns off and the spring 67 retracts the shaft 66. A single actuator and locking mechanism 63 can be used, however, preferably a pair of actuator and locking mechanisms 63 are used, with one actuator and locking mechanism 63 being

mounted on top of the car 30 and the other being mounted below the car. The sill 38 is preferably mounted for movement with the shaft 66 of the actuator and locking mechanism 63 mounted underneath the car 30. Optionally, a separate actuator can be used to control movement of the sill 38.

Another example of an actuator 56 is shown in Figures 10A and 11A. In this configuration, the actuator 56 comprises an electric motor 68 having an output 70 that drives the arm 54. The arm 54 is positioned between a pair of guides 72 that cooperate with the arm to guide the arm 54 as the arm 54 moves between latched and unlatched positions. The motor 68 provides a rotational input force to drive the arm 54 in a first direction to unlatch the hook 58, as shown in Figure 10A. The motor 68 provides a rotational input force to drive the arm 54 in an opposite direction to latch the hook 58 into engagement with the pin 60, as shown in Figure 11A. In this example configuration, there is no need for the resilient spring 62, although one may be provided to ensure a return of the arm 54 in the event that the motor 68 fails.

A return mechanism 90 for the actuator 56 shown in Figures 10A and 11A is depicted in Figures 10B and 11B. The return mechanism 90 is incorporated into the hook area for feedback that the hook 58 is engaged and holding. The return mechanism 90 comprises a spring-loaded switch 92. A spring 94 reacts between a switch housing 96 and a base portion 98 associated with the arm 54. The switch 92 provides feedback 100 to the door moving mechanism 50. In the unlocked position (Figure 10B), the spring 94 is extended, the switch 92 is closed, i.e., the base portion 98 is in contact with switch 92, and feedback 100 is given that the car 30 can be moved. In the locked position (Figure 11B), the spring 94 is compressed, the switch 92 is open, and feedback 10 is given that the doors 34, 36 can be opened. When the motor 68 moves the arm 54 to unlock the hook 58 from the pin 60, the spring 94 acts to close the switch 92.

The extendable sill 38 can also be used to accommodate misalignment between the elevator car 30 and the landing 24. As shown in Figure 12, the sill 38 extends outwardly from underneath a car floor 76 towards the landing sill structure 40 supported by the landing 24. The sill 38 cooperates with a guide or a pivot 78 that forces the sill 38 to sweep upwardly, above the landing sill structure 40, prior to

engagement with the landing sill structure 40. The sill 38 then sweeps down to contact the landing sill structure 40. This accommodates a configuration where the elevator car 30 is higher than the landing sill structure 40 (Figure 13A) and a configuration where the elevator car 30 is lower than the landing sill structure (Figure 13B).

In another example, see Figure 14, a sill 80 is mounted for movement with the elevator car 30. The sill is pivotally mounted to the car floor 76 with a pin 82 or similar component. The sill 80 rotates down to the proper location to engage the landing sill structure 40. Upon contacting the sill 80, the door operator or moving mechanism 50 releases to allow the doors 34, 36 to open.

Another example of an actuator and locking mechanism 110 is shown in Figures 15A-C. The actuator and locking mechanism 110 includes a solenoid 112 with an extendable rod 114. Mounted for movement with a distal end of the rod 14 are locking elements 116. When the car 30 lines up with the landing 24, the solenoid 112 pushes the rod 114 into a hole 118 formed with the hoistway wall 32. The locking elements 116 extend outwardly from the rod 114 to hold the rod 114 in place. The locking elements 116 can be spring-loaded to retract and latch automatically upon the rod 114 being inserted through the hole 118. The retraction operation could pull on an extension release while retracting the rod 114, in a manner similar to a ratchet release.

Another example of an actuator and locking mechanism 120 is shown in Figures 16A-C. The actuator and locking mechanism 120 includes a first solenoid 122, a second solenoid 124, and a coupler 126 interconnecting the first 122 and second 124 solenoids. The first solenoid 122 includes a first shaft 128 with a locking element 130 mounted on a distal end. The second solenoid 124 includes a second shaft 132 that drives the coupler 126. The coupler 126 is mounted on the first shaft 128.

When the car 30 lines up with the landing 24, the first solenoid 122 pushes the first shaft 128 and locking element 130 through a hole 134 formed in the hoistway wall 32. A sensor (not shown) identifies when the shaft 128 reaches the end position. Then, the second solenoid 124 rotates the first shaft 128 via the coupler 126, which turns the locking element 130 ninety degrees (90°) to prevent

removal of the first shaft 128 and locking element 130 from retracting from the hole 134, and to lock the car 30 in place. The first solenoid 122 will attempt to retract prior to releasing the door moving mechanism 50.

In each of the embodiments discussed above, the actuators and associated locking mechanisms could be located above, below, and/or on the sides of the elevator car. Further, the sill 38 can be moved by the same actuator as the locking mechanism or could be controlled by a separate actuator.

The unique, extendable sill 38 allows for quicker installation of the car assembly and provides more running clearance, which results in a softer ride and decreased guidance system component wear. Further, because the running clearance is greater, the gaps to the landing sills are also increased, which decreases aerodynamic pulse events generated as the elevator moves past landings. An additional benefit includes the opportunity to use a simplified door moving mechanism and interlock that does not require high accuracy vanes that restrict the amount of float that the guidance system can use. The subject invention can also be used with less initial landing alignment accuracy because the sill can be extended and adjusted without introducing a step at the landing sill to accommodate slight misalignments between the car and the landing. This decreases sensor and drive systems needs and improves landing speed.

The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The scope of legal protection given to this invention can only be determined by studying the following claims.